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(19)(CA) **CANADIAN PATENT** (12)

(54) Reformers, Particularly Autothermic Secondary Reformers

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ABSTRACT

A reformer, particularly an autothermic secondary reformer, is equipped with a central gas feed pipe penetrating the catalyst bed from the lower side and connected to a mixing and reaction chamber. A feeding device for the oxidizing agent is arranged at least at one level above the catalyst bed and penetrates reaction chamber wall from the external side, the device consisting of at least two inlet nozzles. The outlet end of centre feed pipe is located near the level of the feeding device for the oxidizing agent or above said level.

Reformers, particularly autothermic secondary reformers

The invention relates to a reformer, particularly to an autothermic secondary reformer, equipped with a gas feed pipe arranged in the centre, penetrating the catalyst bed from the lower side and connected to a mixing and reaction chamber, and with a feeding device for the oxidizing agent.

Patent DE-C 37 35 193 describes such a reformer which has a common feed pipe for gas and oxidizing agent, said pipes being arranged in the centre, penetrating the catalyst bed from the lower side and communicating with the upper section of the reaction chamber. This unsophisticated design of a common inlet stream of process gas and oxidizing agent, however, may cause insufficient mixing and distribution of the two components required to optimize the reaction process in the catalyst bed. The reactor described in
DE-A 15 42 539 is of the cross-flow type.

The aim of the invention is to design a device for an optimum distribution of the oxidizing agent and a thorough mixing with the process gas by means of a centre feed pipe penetrating the reactor from the lower end.

The invention provides for a reactor of the type mentioned above, with a feeding device arranged at one level above the catalyst bed, penetrating the reaction chamber wall from the external side and consisting of at least two inlet nozzles.

Said inlet nozzles are used as mixing and distributing components and permit and optimum mixing of the reactants in the combustion chamber.

DE-A 28 41 127 describes a seondary reformer in which jet-type elements are deployed for mixing and distributing the oxidizing agent and the process gas. The disadvantage of this design is that the process gas is not fed via a centre pipe through the catalyst bed into the mixing and reaction chamber, the inherent merits of the centre pipe thus being abandoned. This applies also to the configuration recommended in DE-A 35 32 413.

According to a further embodiment, a specific advantage is obtained by arranging the gas outlet of the centre feed pipe for the process gas on the level of the oxidizing agent inlet or even higher in order to optimize gas mixing.

It is useful to place the gas feed pipe outlet and the feed nozzles in parallel and to arranged them vertically to the vertical centre axis of the mixing and reaction chamber.

The embodiment of the invention provides for inlet nozzles that are flush with the internal side of the internal liner. A circular feed line may be provided for the supply of the fluids to the inlet valves.

According to a further embodiment of the invention, a distributor is mounted to the outlet of the centre feed pipe and - as a specific feature - it is designed as swirl inducer. This construction improves and intensifies the swirl effect in the mixing and reaction chamber, the gas leaving the chamber at a substantially lower temperature and forming a protective blanket around the distributor.

In this case, it is recommended that the vertical axis of the box-type gas distributor coincide with that of the mixing and reaction chamber and that the distributor be provided with external oblong holes flanked by vertical deflectors.

It is of particular advantage to place the deflectors symmetrically to the vertical axis of the mixing and reaction chamber, i.e. at an angle of <90° measured from the radius; it is also possible to arrange the axis of the inlet nozzles at an angle of <90° measured from the radius concerned, which serves to optimize the flow pattern. This special inlet configuration also permits a larger space for the flame by providing an adequate coning angle. The invention also provides for inlet nozzles that can be placed at a certain angle measured from the position of their free ends.

It is of course possible to provide a cooler for the inlet nozzles, said cooler having a closed or open jacket cooled by water, steam, etc.

It may also be useful to equip the inlet nozzles with a device for controlling the flame shape.

The drawings and diagrams listed below serve to illustrate the invention:

Fig. 1: cross-sectional view of the upper part of a secondary reformer according to the invention

Fig. 2: cross-sectional view II-II of the device in Fig. 1.

The secondary reformer (1) shown in the figures has - inter alia - reaction chamber 2 and gas feed pipe 3 placed in the centre, said pipe penetrating catalyst bed 4 and communicating with mixing and reaction chamber 5.

The outlet of gas feed pipe 3 is equipped with gas distributor 6, inlet nozzles 7 for the oxidizing agent being arranged underneath the outlet end of feed pipe 3 and fed via circular feed line 3.

Fig. 2 shows feed nozzles 7 which are flush with the internal liner of reaction chamber wall 2 and arranged at angle a measured from the vessel radius 11 and, if required, at an angle b (Fig. 1). Gas distributor 6 has deflectors 10 which form an angle d measured from the vessel radius 11. Arrows 12 indicate the process gas stream and when the process gas and oxidizing agent are mixed, the flames are ignited and burn in the manner shown in Fig. 2 (flame shape 13).

The process takes place as follows:

The process gas stream leaving the central feed pipe 6 flow in a swirl-type manner due to deflectors 10. Said gas streams mix with the oxidizing agent fed by means of nozzles into the mixing and reaction chamber 5 so that the reaction gas is oxidized. The reaction product subsequently flows through the catalyst bed.

It is of course possible to modify the embodiment of the invention described above without abandoning the basic configuration. Thus, the invention is not limited to the type of gas distributor described above. The deflectors may be curved or bent and their thickness is variable. Nozzles may be installed in the head of gas feed pipe 3 instead of the circular inlet ducts formed by the deflectors.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A reformer, in particular an autothermal secondary reformer, comprising a gas feed which is passed centrally from below through the catalyst into a mixing or reaction chamber, and an oxidation agent feed, wherein in at least one plane above the catalyst bed are at least two feed nozzles for feeding the oxidation agent, which pass through the internal insulation from the outside inwardly, wherein the outlet end of the central gas feed is disposed in the plane of the oxidation agent feed or in a still higher plane above the plane of the oxidation agent feeds.

2. A reformer according to claim 1 wherein the feed nozzles are aligned with the inside of the insulation.

3. A reformer according to claim 1 or claim 2 wherein there is provided a supply conduit in ring form for supplying the feed nozzles.

4. A reformer according to claim 1 or claim 2 wherein the central gas feed is provided at its outlet end with a gas distributor.

5. A reformer according to claim 1 or claim 2 wherein the plane in which the outlet end of the gas feed is disposed and the plane in which the feed nozzles are arranged extend parallel to each other and perpendicularly to the vertical centre line of the

mixing and reaction chamber.

6. A reformer according to claim 4 wherein the gas distributor is in the form of a swirl-producing element.

7. A reformer according to claim 4 wherein the gas distributor comprises a housing whose vertical centre line coincides with the vertical centre line of the mixing or reaction chamber and at its outside has slit-shaped openings which are defined by vertical guide walls.

8. A reformer according to claim 7 wherein the guide walls are arranged symmetrically relative to the vertical centre line of the mixing and reaction chamber and are set at an angle δ of less than 90^{o} relative to the associated radius.

9. A reformer according to claim 1 wherein the feed nozzles are set at an angle α of between 25 and 45^{o} relative to the associated radius.

10. A reformer according to one of claims 1, 2, or 9 wherein the feed nozzles are provided with a cooling device and with a device for influencing the flame shape.

11. A reformer according to claim 10 wherein the cooling

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device comprises a cooling agent flowing in a closed or open double casing.

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PATENT AGENTS

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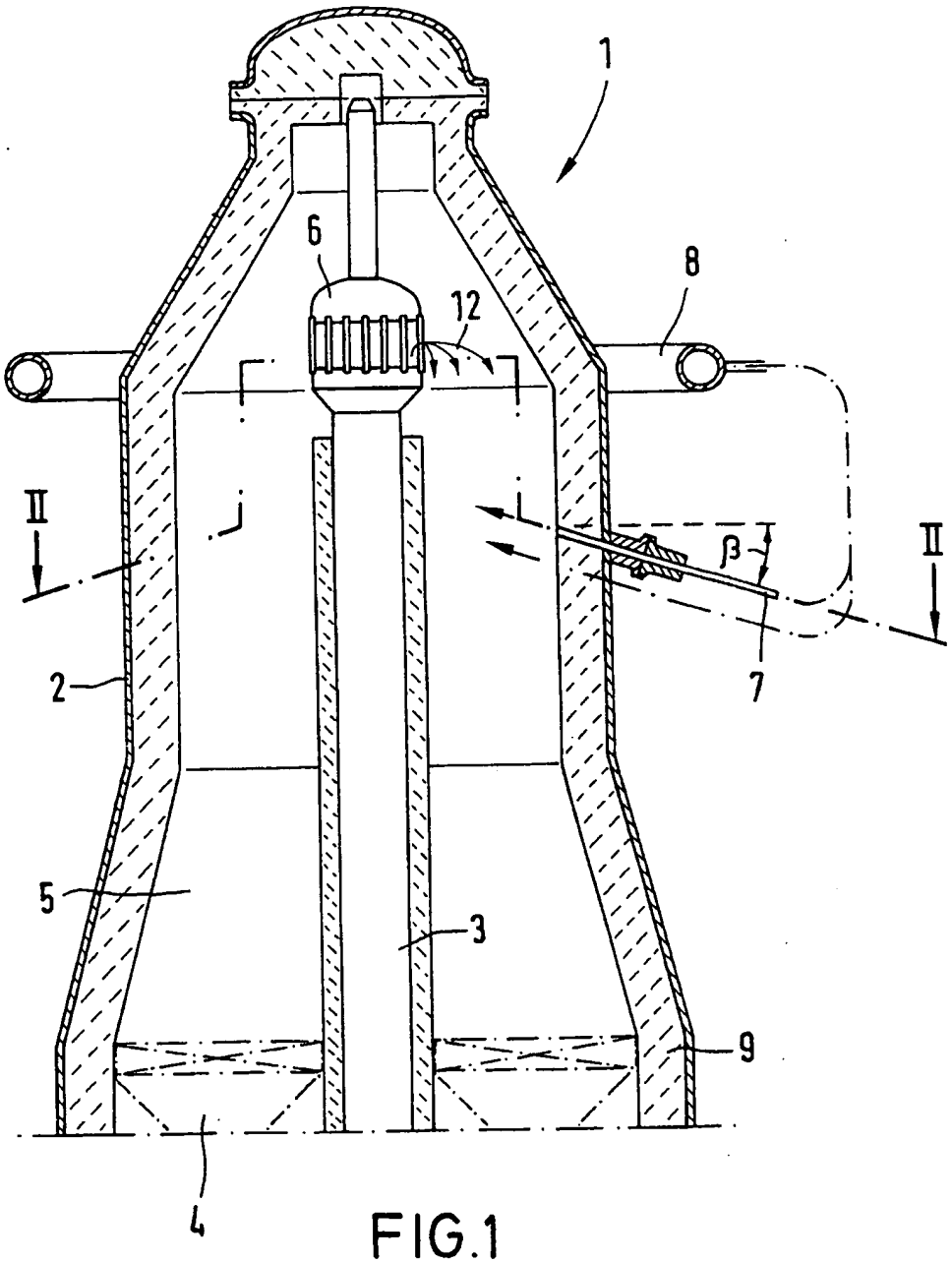

FIG.1

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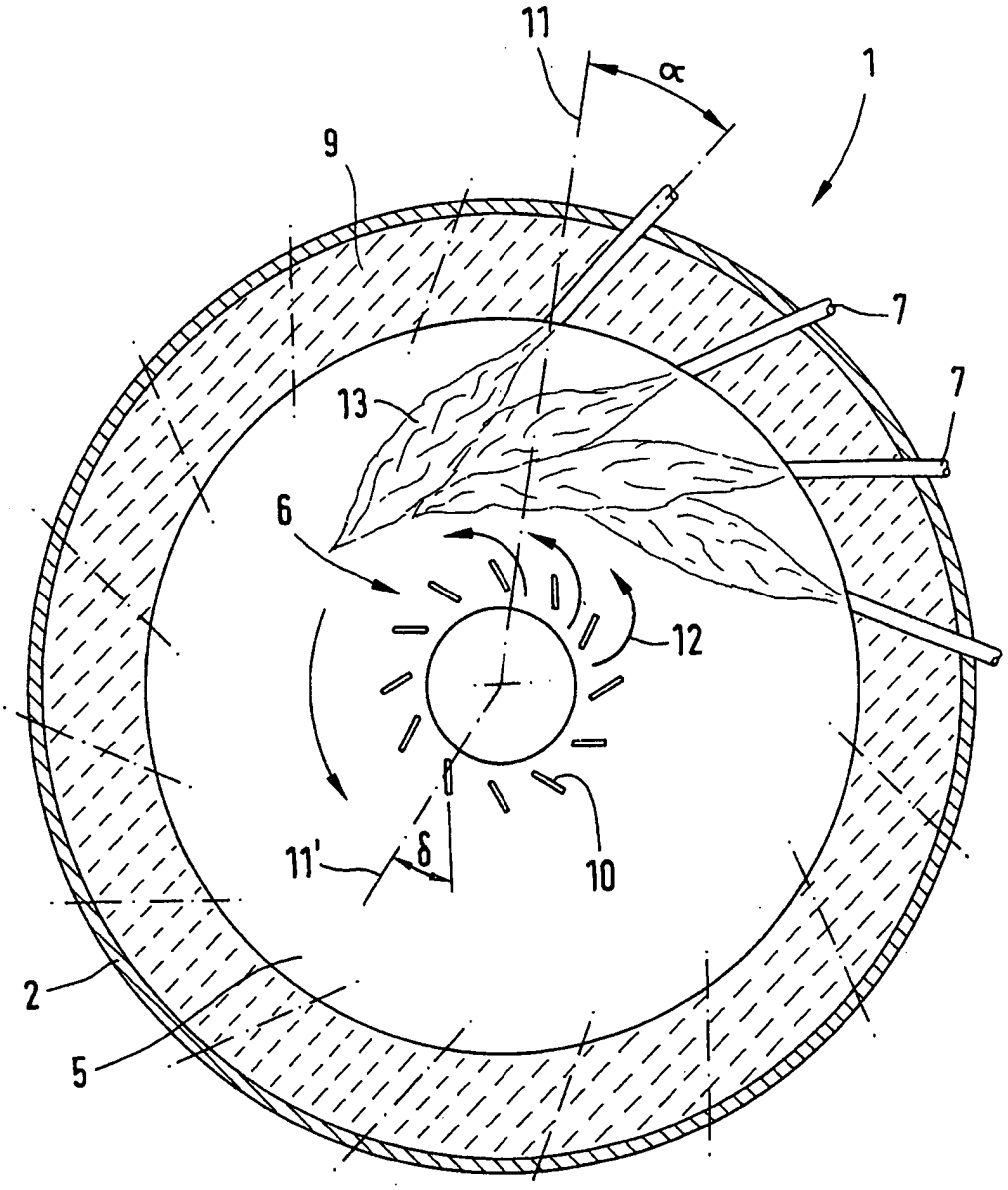

FIG.2